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Leadership in a Public Goods Experiment with Permanent and Temporary Members*

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Abstract: We experimentally analyze leading by example in a public goods game with two permanent and two temporary group members. Our results show that leadership when permanent and temporary members interact leads to lower contributions than interaction without leadership.

Keywords: Cooperation; leadership; social dilemma; public goods provision; experiment.
JEL classification: C91, D03, D64.

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1. Introduction

Social dilemmas pose a problem for society. It is in the collective interest to cooperate in order to overcome the dilemma, for instance, in order to provide a public good. However, it is in everyone's private interest to free-ride on other group members to maximize one's profit. The experimental literature has shown convincingly that, even among conditionally cooperative individuals, the level of cooperation in social dilemma declines over time in repeated interaction unless there is an enforcement mechanism to coerce those who have a tendency to free-ride on others or those who follow a self-serving notion of conditional cooperation, contributing less than the average group contribution (e.g., Fehr and Gächter, 2000; Fischbacher et al., 2001; Fischbacher and Gächter, 2010; Fischbacher et al., 2012).

The dilemma becomes worse for smaller numbers of repeated interactions and for changing group membership (Grund et al., 2015). Consider a community that wants to dispose of different kinds of waste – such as glass, paper, and plastic – properly (a social dilemma). During tourist season, typically there are people with a long-term perspective (regular inhabitants) and people with a short-term perspective (tourists). In the following we refer to permanent group members as *Perms* and to temporary group members as *Temps*. Perms remain in their group for the entire repeated interaction, whereas Temps change groups every period (see, relatedly, Angelova et al., 2012; Grund et al., 2018).

Our experiment employs a mechanism which has been shown to enhance voluntary cooperation and efficiency in public goods provision, namely leading by example (e.g., Güth et al., 2007; Potters et al., 2007; Rivas and Sutter, 2011; Drouvelis and Nosenzo, 2013; Brandts et al., 2016; Drouvelis et al., 2017; Gächter and Renner, 2018). Will it be able to counterbalance or at least weaken the negative effects due to the co-involvement of Perms and Temps in a public goods game? Specifically, we assign leadership to a pair of Perms, respectively Temps, in a public goods game with two Perms and two Temps in the group, compared to a control condition with simultaneous contributions.

Our main results show surprisingly that "leading by example" in the interaction between Perms and Temps in social dilemmas leads to even lower contributions than without leadership. This result is largely driven by the behavior of Perms. While Perms tend to provide a good example as leaders, they are contaminated by the bad example of less contributing Temp-leaders.

2. Experimental design

Participants play a linear public goods game in groups of four members for ten periods. In each period, each member receives an endowment of 20 tokens and decides on how much to contribute to a private and to a public good, respectively. The payoff function for subject $i = 1, 2, 3, 4$ is

$$\pi_i = 20 - c_i + 0.5\sum_{j=1}^{4} c_j \,, \tag{1}$$

where c_i is the contribution of subject *i* to the public good. Assuming that subjects are selfish and rational, the dominant strategy for any marginal per capita return below one is to free ride, i.e. to contribute nothing to the public good.

For opportunistic (own payoff maximizing) subjects, the dominant strategy is to free ride, i.e. to contribute nothing to the public good. Whereas common free-riding lets each earn 20, each would earn 40 when all fully contribute.

Each subject is for the entire ten periods randomly assigned to the role of a Perm or Temp. Groups consist of two Perms and two Temps. Perms stay together with the same Perm, while Temps switch to different new groups after each period, and participants are aware of this group restructuring. Participants are explicitly informed that the two Temps will never belong to the same group in two consecutive periods, i.e. Temps confront three new interaction partners in the next period, Perms – only two.

The three conditions vary the timing of the contributions. In the control condition SIMULT, Perms and Temps contribute to the public good at the same time (simultaneously). In condition PERMFIRST, both Perms contribute simultaneously and independently before both Temps contribute simultaneously and independently, aware of previous contributions of the other type. In condition TEMPFIRST, both Temps contribute before the two Perms decide. At the end of each period, subjects are informed about the contributions of all four group members and their own payoff.

A novel aspect of this experimental setup is that there is strategic uncertainty in both, leading and following. Leading by example has been mostly investigated with only one leader confronting one or more followers so far. Leaders have to anticipate how followers behave. Followers may face the conflict between following a good example, when they are reciprocity-inclined, or to yield to free-riding incentives. Both, regardless whether they are leaders or followers, also may be concerned how the other Perm, respectively Temp behaves.

Points earned in the experiment are added up and converted to EUR at an exchange rate of 25 points = 1 EUR. Average earnings are 11.9 EUR. Subjects receive their payments in cash at the end of the experiment.[1] Every subject participated in one condition only. We recruited 72 subjects per condition with ORSEE (Greiner 2015). Subjects in each condition were divided into six matching groups (i.e. independent observations) of 12 subjects. Subjects were assigned and reassigned to a group of four only within their own matching group. Except for the restricted re-matching, all design details were common knowledge

[1] Before the main part of the experiment we elicited conditional contributions, following Fischbacher et al. (2001). Feedback for the elicitation was given only after the main part.

among participants. The experiment was programmed with zTree (Fischbacher, 2007). The neutrally framed experimental instructions (see Online Appendix, Part B) were read aloud. Roles Perm and Temp were neutrally denoted as roles A and B.

3. Results

We start by looking at average contributions by condition. Figure 1 plots average contributions (left panel) and average contributions over time (right panel) by condition.

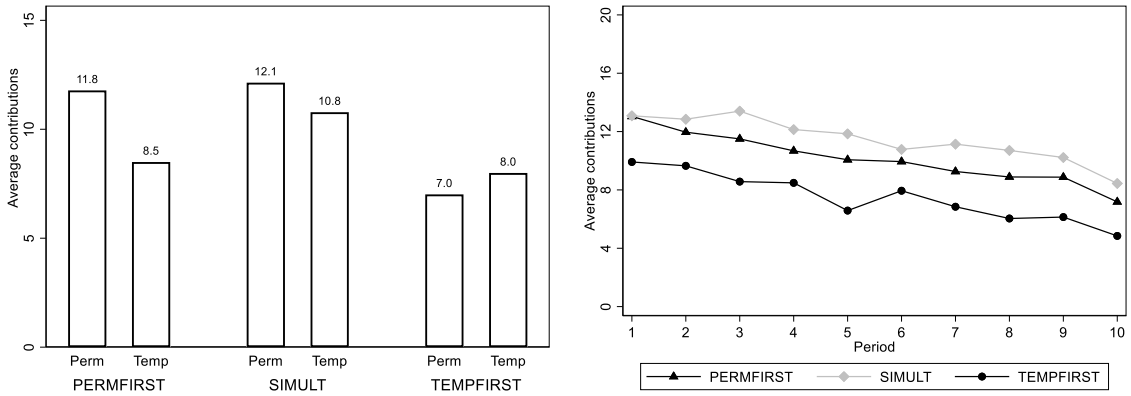

Figure 1: Average contributions by condition and type of group member

As can be seen, average contributions amount to 11.5 out of 20 tokens in condition SIMULT. Leadership, when two Perms and two Temps interact, clearly does not lead to higher average contributions. In PERMFIRST, average contributions are 10.2, and in TEMPFIRST they are 7.5. Leadership seems to reduce the average contribution not only overall but also for the two group member types. Despite the lower contribution levels, we confirm the usual tendency of the leaders to contribute more than the followers, where this is more pronounced for Perms as leaders than for Temps as leaders. There is only a small “tenure effect”, manifested in SIMULT by the positive difference between the average contribution of Perms and Temps. The “leadership effect” in PERMFIRST strengthens this by enlarging the difference. In TEMPFIRST, both effects go in opposite directions with the leadership effect being stronger. In the right-hand panel of Figure 1, it is easy to discern that all conditions and all types display declining contributions over time.

The regression analysis in Table 1 provides estimates from GLS regressions. We account for repeated decisions by the same subject and correlated decisions within the same matching group by including subject-specific random effects and by clustering standard errors at the matching-group level. Results are robust to using Tobit random effects models. We compare individual contributions across conditions for all subjects in model (1), and

separately for Perms in (2a) and Temps in (2b). Models (3a)-(3c) use condition- specific data to compare average contributions of Perms to those of Temps within the same condition. Finally, model (4) includes all possible interaction effects between condition and type of group member for the whole dataset.

Dep. variable: Individual contribution	All (1)	Perms (2a)	Temps (2b)	PERM-FIRST (3a)	SIMULT (3b)	TEMP-FIRST (3c)	All (4)
PERMFIRST dummy	-1.321 (1.0094)	-0.356 (1.2037)	-2.286* (1.2916)				-2.286* (1.2916)
TEMPFIRST dummy	-3.958** (1.6083)	-5.128*** (1.8096)	-2.789* (1.6462)				-2.789* (1.6462)
Perm dummy				3.286*** (1.008)	1.356 (1.194)	-0.983 (0.632)	1.356 (1.1212)
PERMFIRST dummy * Perm dummy							1.931 (1.4675)
TEMPFIRST dummy * Perm dummy							-2.339* (1.2686)
Period	-0.517*** (0.0697)	-0.496*** (0.0787)	-0.537*** (0.0852)	-0.556*** (0.119)	-0.471*** (0.0809)	-0.524*** (0.168)	-0.517*** (0.0697)
Constant	14.30*** (0.910)	14.87*** (1.192)	13.74*** (1.081)	11.56*** (0.926)	13.37*** (1.192)	10.88*** (1.769)	13.63*** (0.9674)
α(PERMFIRST) = =ß(TEMPFIRST), (p-value of Wald test)	0.0867	0.0016	0.7749				
Observations	2160	1080	1080	720	720	720	2160
No. of subjects	216	108	108	72	72	72	216

Note: Coefficients from GLS regressions with standard errors in parentheses, random effects on the subject level and standard errors clustered at the matching group level, reference category in (1), (2a), and (2b) is SIMULT; (3a,b,c) use only condition-specific data, reference category is Temp; * p<0.1, **p<0.05, ***p<0.01.

Table 1: Explaining individual contributions

Model (1) shows that leadership leads to lower average contributions, which is only significant in TEMPFIRST. Models (2) reveal the reason for the overall difference between SIMULT and TEMPFIRST. While Temps reduce their contributions to a similar extent in PERMFIRST and TEMPFIRST, compared to SIMULT, see (2b), Perms contribute much less in TEMPFIRST, see (2a). Both, PERMFIRST and TEMPFIRST, confirm that leaders contribute more, but the effect is only significant in PERMFIRST, see (3). When contributions are made simultaneously, Perms and Temps contribute similarly. This is another surprising and interesting result since at least the two Perms interact repeatedly. Apparently just one constant partner when interacting with three others does not suffice to trigger significant repeated interaction effects. The decline of contributions over time is very similar across conditions and types. Model (4) confirms the insights from models (1) to (3) (see also Online Appendix, Part A).

What drives the behavior of Perms in the role of followers? The analysis of group dynamics combined with initial behavior provides some insights.[2] In period 1, Perm-leaders and Temp-followers do not display different average behavior than in SIMULT. In contrast, Temp-leaders and Perm-followers contribute less. In the following periods of all conditions, Temps positively link their contribution to the latest contribution of Perms. The contribution of a Perm in SIMULT and PERMFIRST is positively affected by both, the latest contribution of the other Perm, as well as the latest average contribution of both Temps, with the relative importance of the two being similar. This is quite different in TEMPFIRST, where Perms completely neglect the behavior of their fellow-Perm and only follow the Temps. This leads to a spiral during play of the experiment in TEMPFIRST: Temps start off with a lower contribution than in SIMULT, Perms follow them; in the next period, Temps reduce again, following Perms, Perms in turn follow Temps, and so on. This explains why average contributions over the ten periods in TEMPFIRST are lower than in the other two conditions.

To sum up, introducing leading by example in groups consisting of permanent and temporary group members does not increase average contributions compared to the case, when contributions are made simultaneously. While Temps contribute similarly as leaders and as followers, Perms contribute much less as followers. This is, because as followers, Perms condition their contributions only on the contributions of the Temp-leaders, whose initial contributions are low, and later on themselves conditioned on the average contributions of Perms. The leadership of Temps possibly makes the one-shot nature of the interaction with them more salient for Perms.

4. Conclusion

We implement leadership without coercive, i.e. sanctioning, power using a “leading by example” mechanism in a public goods setting with groups consisting of two Perms and two Temps by letting the two members of the same type, Perm versus Temp, contribute either before or after the other type. Only the control let all four members decide simultaneously. Our setup thus captures field social dilemma cases whose parties differ in tenure.

Surprisingly, leadership in interactions of Perms and Temps leads to even lower contributions than in the control condition. This questions existing results of no negative and mostly positive effect of leading by example on voluntary contributions in cooperation games. Our effect is mainly driven by Perms. While Perm-leaders try to provide a good example, Perms’ contributions decay very quickly when Temps lead.

How to explain this surprising result? Possibly, the novelty of our design, namely the strategic uncertainty in both, leading and following, creates additional coordination problems.

[2] Here we only report the results. The complete analysis is provided in Online Appendix, Part A.

An interesting extension of our design would be a setup with only one leader and three followers.

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Online Appendix (not for publication)

Appendix A Regression Analysis

Regression model (4) in Table 1

Regression equation:

$$Contribution_{it} = \alpha \cdot \text{PERMFIRST dummy} + \beta \cdot \text{TEMPFIRST dummy} + \gamma \cdot \text{Perm dummy} + \delta \cdot \text{PERMFIRST dummy} \cdot \text{Perm dummy} + \mu \cdot \text{TEMPFIRST dummy} + \lambda \cdot \text{period} + \text{const} + \varepsilon_{it}$$

Table A1 reports the p-values from the post-estimation Wald tests related to regression (4) in Table 1 and the corresponding interpretation. The insights confirm those from models (1) to (3) in Table 1.

Null hypothesis of Post-estimation Wald tests	p-value	Interpretation
$\alpha = \beta$	0.7749	Temps contribute similarly in PERMFIRST and TEMPFIRST.
$\alpha = 0$	0.0767	Temps contribute less in PERMFIRST than in SIMULT.
$\beta = 0$	0.0902	Temps contribute less in TEMPFIRST than in SIMULT.
$\alpha = \gamma + \delta$	0.0069	In PERMFIRST, Perms contribute more than Temps.
$\gamma = 0$	0.2267	In SIMULT, Perms and Temps contribute similarly.
$\beta = \gamma + \mu$	0.3294	In TEMPFIRST, Perms and Temps contribute similarly.
$\gamma + \delta = \gamma + \mu$	0.0001	Perms contribute less in TEMPFIRST than in PERMFIRST.
$\gamma = \gamma + \delta$	0.1883	Perms contribute similarly in SIMULT and PERMFIRST.
$\gamma = \gamma + \mu$	0.0652	Perms contribute less in TEMPFIRST than in SIMULT.

Table A1. Results from post-estimation Wald tests

Dependent variable: individual contribution	(1) SIMULT Perm	(2) SIMULT Temp	(3) PERMFIRST Perm	(4) PERMFIRST Temp	(5) TEMPFIRST Perm	(6) TEMPFIRST Temp
Lagged contribution by the other Perm	0.304*** (0.0917)		0.273*** (0.0965)		0.0468 (0.0817)	
Mean lagged contribution by the two Temps	0.190*** (0.0547)		0.219*** (0.0751)			
Mean lagged contribution by the two Perms		0.0850*** (0.0157)				0.284*** (0.0691)
Lagged contribution by the other Temp		-0.0378 (0.0565)		0.0209 (0.0274)		-0.00568 (0.0422)
Mean contribution by the two Perms				0.579*** (0.120)		
Mean contribution by the two Temps					0.804*** (0.0922)	
Period	-0.386*** (0.0817)	-0.454** (0.224)	-0.250 (0.160)	-0.246** (0.102)	-0.150* (0.0842)	-0.322** (0.150)
Constant	8.467*** (1.954)	12.56*** (2.198)	7.876*** (1.228)	2.583** (1.098)	0.990 (0.882)	7.672*** (1.807)
Observations	324	324	324	324	324	324
Number of subjects	36	36	36	36	36	36

Note: Coefficients from GLS regressions with standard errors in parentheses, random effects on the subject level and standard errors clustered at the matching group level, * p<0.1, **p<0.05, ***p<0.01, comparison of the coefficients for the contributions, Wald tests: p=0.2697 in (1), p=0.0726 in (2), p=0.7499 in (3), p=0.0000 in (4), p=0.0000 in (5), p=0.0028 in (6).

Table A2. Individual contributions explained by the current and past contributions of the different group members, by type of group member and condition

In Table A2 we study how individual contributions are affected by the information about the latest contributions of the other group members. For each group member type and for each condition, we regress the individual contribution on the two latest contributions seen by the individual before making a decision. For instance, the latest contributions a Perm-leader would see, would be those by the other Perm and the other two Temps in the previous period. The latest contributions a Temp-follower would see, would be those of the two Perms in the same period and that of the other Temp in the previous period. For simplicity and without loss of generality, we always take the average of the two contributions by the group members of the opposite type.

Our regression analysis shows that Temps follow the behavior of Perms in all conditions, neglecting what the fellow Temp does. When deciding simultaneously or first, Perms' contributions are positively and significantly correlated with the contributions of all other group members. Thereby, the behavior of the other Perm is as important as that of the Temps. When deciding as followers, Perms pay attention to the average contribution of the

two Temps (correlation is positive and significant), neglecting the behavior of their fellow Perm.

Table A3 reports differences in first-period behavior across conditions. Perms contribute similarly in SIMULT and PERMFIRST. The same is true for Temps. In TEMPFIRST, both the contributions of Perms and Temps are below the respective ones in SIMULT.

Taking together the insights from Tables A2 and A3, it seems that SIMULT and PERMFIRST do not differ much with respect to first-period behavior and group dynamics during the experiment, while behavior in TEMPFIRST is different for both. This explains the differences in average contributions between TEMPFIRST and the other two conditions.

Dep. var.: Individual contribution in period 1	(1) Perm	(2) Temp	(3) All
PERMFIRST	0.500	-0.583	-0.0417
	(1.126)	(1.543)	(0.876)
TEMPFIRST	-2.917*	-3.417*	-3.167**
	(1.577)	(1.668)	(1.354)
Constant	12.81***	13.36***	13.08***
	(1.025)	(1.009)	(0.607)
Observations	108	108	216
R-squared	0.054	0.054	0.052
α(PERMFIRST)= β(TEMPFIRST)	0.0167	0.1275	0.0350

Note: OLS regressions with clustered standard errors at the matching group level, *** p<0.01, ** p<0.05, * p<0.1

Table A3. Comparison between conditions in period 1

Appendix B Experimental instructions

The original instructions were in German. We provide a translation for condition TEMPFIRST. In Italic font and in brackets, we indicate how the instructions differ from those in the other conditions.

Welcome to this experiment and thank you for your participation!

From now on, please do not talk to other participants.

General information

This is an experiment on economic decision-making. During the experiment, you can earn money. After the experiment you will receive the money privately and in cash.

The experiment will last approximately one and a half hours, and consists of 2 parts. At the beginning of each part, you will receive detailed instructions. Both parts are independent of each other. Decisions made in one part will not affect your payoff in the other part. Your total payoff from the experiment will be equal to the sum of your payoffs from part 1 and part 2. We will inform you about your total payoff after part 2 is finished.

If you have questions at any time during the experiment, please raise your hand. One of the experimenters will come and answer your questions privately.

During the experiment, we will ask you and the other participants to make decisions. You will also be interacting with other participants. This means that your own decisions as well as the decisions of the other participants may affect your payoff.

Payoffs

During the experiment, we will talk about points instead of euros. These points will be converted to euros at the end of the experiment. We will inform you about the exchange rate for each part separately.

Anonymity

We never relate names to decisions in the experiment. At the end of the experiment, you will be requested to fill out and sign a receipt for accounting reasons. Our accountants will also not be able to relate your name to your decisions.

The decision situation

We will first explain the decision situation. After that, we will ask you to answer some questions on your screen that will help you to better understand the decision situation. Finally, we will explain your task in part 1.

You will participate in a group of four. Every group member will have to decide on how to use her 20 points. You can deposit them in your private account or you can contribute all of them or part of them to the group account. Every point that you do not contribute to the group account, automatically goes to your private account.

Income from the private account

Each point that you deposit in the private account, earns you exactly one point. For instance, if you deposit 20 points in the private account, you will earn exactly 20 points from

the private account. If you deposit 6 points in the private account, you will earn 6 points from the private account. **Nobody besides you earns money from your private account.**

Income from the group account

All four group members profit in the same way from the amount that you deposit in the group account. This means that you will also benefit from the amounts that other group members deposit in the group account. The income of each group member from the group account is given by:

Individual income from the group account = Sum of the contributions of all four group members to the group account $\times$ 0.5

For example, if the sum of the contributions of all four group members to the group account is 80 points, then each group member will earn $80 \times 0.5 = 40$ points from the group account. If the four group members contribute a total of 10 points to the group account, each group member will receive $10 \times 0.5 = 5$ points from the group account.

Total income

Your total income is equal to the sum of your income from the private account and your income from the group account. Hence,

Income from the private account (= 20 – contribution to the group account)
+ income from the group account (= 0,5 $\times$ sum of the contributions to the group account)
= total income

Quiz

Before you read further, we would like you to answer some questions on your computer screen. If you would like to perform calculations now or later during the experiment, you may use the Windows Calculator. If you have questions, please raise your hand. We will come and answer them in private.

Part 1

Task eliciting conditional contributions. Instructions are available upon request.

(Instructions for Part 2 were distributed after Part 1 was finished. Participants received feedback about Part 1 after Part 2 was over.)

Part 2

Part 2 consists of **ten identical periods.** In every period, you will face the decision situation described above. In the following we will describe some additional aspects.

Unconditional contribution

In each period of part 2 you will provide only your unconditional contribution.

Two types of participants

Every participant will randomly be assigned to either role A or role B. **You will have the same role in all periods** (i.e., you will always be participant A, if you start as participant A; you will always be participant B, if you start as participant B). You will be informed about your role on your computer screen when the experiment begins.

Group composition
Your group consists of four members: **two participants A and two participants B**. Both participants **A will stay together in the same group for the entire 10 periods.** In contrast, every participant **B will switch** to a new randomly selected A-A-group **in every period**. N**o participant B will meet the same other participant B in two subsequent periods.**

Sequence of decisions
First, both participants **B** *[PERMFIRST: A]* **will simultaneously decide** on their individual contributions to the group account. **Then, both participants A** *[PERMFIRST: B]* of the same group will be informed about **the individual contributions of participants B** *[PERMFIRST: A]* to the group account**. In the end, both participants A** *[PERMFIRST: B]* **will simultaneously decide** on their individual contributions to the group account.

[SIMULT: All participants will always decide simultaneously on their individual contributions to the group account.]

Information at the end of each period
At the end of each period, you will be informed about how much each of the other group members contributed to the group account and how much you earned in that period.

Payoff at the end of part 2
Your final payoff is the sum of your payoffs in each period. The exchange rate for part 2 is

25 points = 1 EUR

The payoff that you earn in part 2 will be paid to you together with your payoff from part 1 privately and in cash in the end of the experiment.

After part 2 is over, we will ask you to answer a questionnaire. Please do truthfully answer our questions since they are very important for our research. Of course, all your answers will remain anonymous. After you fill out the questionnaire, the experiment will be over. You will be informed about your payoffs from parts 1 and 2 and you will receive your final payoff privately and in cash.